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# NEURAL CORRELATE OF MEMORY ENHANCEMENT DURING PHYSICAL EXERCISE

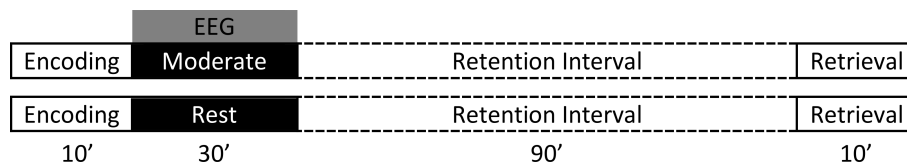
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## Introduction

Research has shown that physical exercise is beneficial for cognitive performance<sup>1</sup>. In addition to psychological effects, many effects are attributable to physiological mechanisms such as increased blood flow and oxygen supply (cardiovascular hypothesis<sup>2</sup>). It is, however, unclear whether any neural mechanisms contribute to this process. In two studies, we explored this possibility by recording EEG while participants were cycling following memorising a set of stimuli for later recognition.

## Study 1

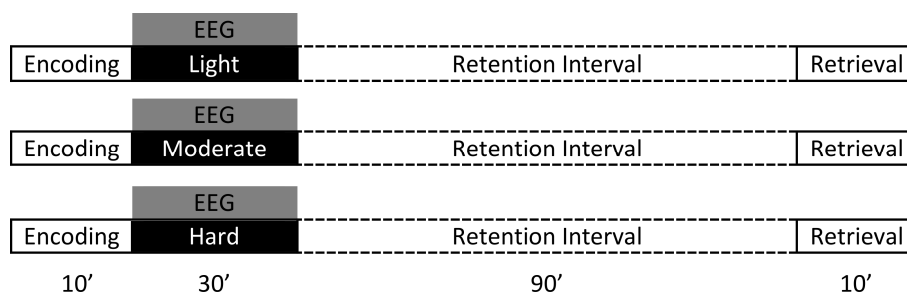


Participants (n = 18) took part in two experimental sessions. Following memorisation, they either cycled with moderate intensity or rested and watched documentaries. Following a retention interval of 90 minutes (watching Friends TV series) they performed an old/new recognition task.

**Behavioural data** showed a significant improvement in memory performance following cycling (Figure 1).

**EEG data** showed a negative correlate of theta band activity at F3 (corresponding to dorsolateral prefrontal cortex) with memory performance difference between the two sessions (cycling – rest) (Figure 2).

## Study 2



Participants (n = 20) took part in three sessions. They cycled in all sessions following the memorisation phase, but with different intensities.

In contrast to the pilot study, **behavioural data** showed no significant difference between the three cycling conditions (Figure 3).

## Conclusions

- Considering results of both studies we speculate that even very easy cycling is enough to significantly improve memory.
- EEG correlate observed in Study 1 provides the first evidence of neural correlate of memory enhancement using physical exercise.
- Negative correlation of theta activity and memory performance is in line with past research showing improved memory performance following lower theta activity during encoding<sup>3-5</sup>.

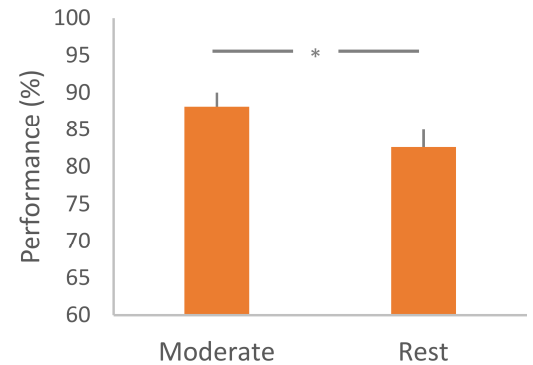


Figure 1. Significant improvement ( $p = .02$ ) in memory performance (Study 1)

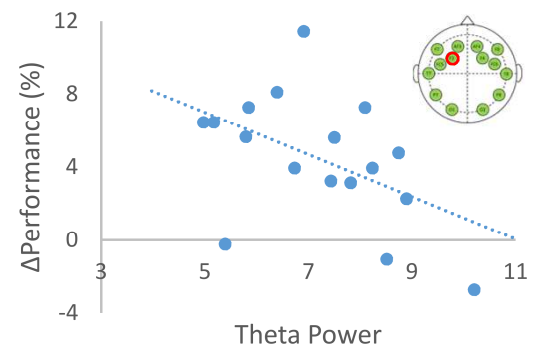


Figure 2. Significant negative correlation ( $p = .04$ ,  $r = .48$ ) of theta power and  $\Delta$ performance (cycling – rest) (Study 1)

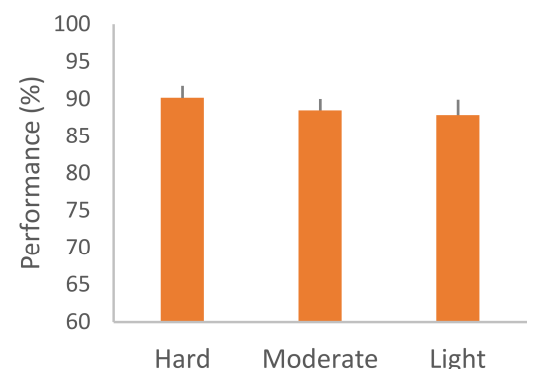


Figure 3. No significant improvement in memory performance (Study 2)

## References

- 1 Hillman CH, et al. (2008) *Nature reviews neuroscience*.
- 2 Etner JL, et al. (2006) *Brain research reviews*.
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- 5 Long NM, et al. (2014) *Neuroimage*.